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TUBULAR BLANK FOR THE PRODUCTION OF DRILLING TOOLS, METHOD FOR THE PRODUCTION OF A BLANK AND METHOD FOR THE PRODUCTION OF DRILLING TOOLS

Description

The invention relates to a tubular blank for the production of drilling tools, the blank having a forming part that can be formed in a non-cutting manner while thereby forming straight or helical chip grooves and coolant channels, and the finished tool being able to be fitted with a shaft for clamping in a machine tool and with a drill tip provided with cutting edges.

It is known from DE-A-198 56 986 to use for the production of a drilling tool a tubular blank which comprises a piece of tube of ductile material with an inside and outside diameter that are constant over its length. For the production of a drill body while thereby forming chip grooves and coolant channels, the blank is formed there in a non-cutting manner by the swaging method and is subsequently fitted at its rear end with a drill shaft for clamping in a machine tool. It is known in this case that the drill shaft is clamped for example on the finished drill body by suitable clamping means (for example screws). For this purpose, a clamping part adjoining the region of the chip groove is required. In the production of actual, operational drills using the known blanks with an inside and outside diameter that are constant over the length, it has been found that, depending on the wall thickness of the blank, either the non-cutting formability in the forming part or the strength in the clamping part leave something to be desired.

Against this background, the invention is based on the object of developing a tubular blank of the type stated at the beginning which allows for the different

preconditions in terms of deformation and strength in the forming part and the clamping part of the drill body.

The combination of features specified in patent claim 1 is proposed as a solution for achieving this object. Advantageous configurations and developments of the invention emerge from the dependent claims.

The solution according to the invention is based on the recognition that, for the production of drilling tools, the blank should have a relatively small material wall thickness in the forming part, in order that adequate deformation can take place with few working steps, while thicker-walled material is required in the region of the clamping part, to allow the forces occurring during clamping to be absorbed. The clamping on the drill shaft takes place for example by means of clamping screws, which act against a clamping area in the clamping part, or by thermal shrink-fitting of the tool shaft onto the clamping part. In the first case, the clamping area causes the material to be thinned in places if they are produced by a metal-cutting process. Since the clamping screws press against the zone where the material is thinned, it must be ensured that adequate material remains when the clamping area is produced. The same applies correspondingly if the clamping area is formed by a non-cutting process, for example in a forging operation. In the case of shrink-fitting, it must be taken into account that the clamping chuck is heated up to an elevated temperature, for example to 400°C, and has a relatively high thermal capacity. This leads on contact to heating up of the clamping part and to reduced strength at the moment of clamping. The wall thickness must therefore be chosen such that the clamping part is not plastically deformed during this clamping operation. In order to allow for these conflicting preconditions, the invention proposes

a clamping part which is arranged at the shaft-side end of the forming part, is integrally connected to the latter and the tubular wall thickness of which is greater than in the region of the forming part.

According to a preferred configuration of the invention, the outside tube diameter is greater in the region of the clamping part than in the region of the forming part. In principle, it is possible in this case for the inside tube diameter to be equal in the region of the clamping part and the forming part, or for the inside tube diameter to be greater or smaller in the region of the clamping part than in the region of the forming part.

A further advantageous configuration of the invention provides that a preferably planar clamping area is arranged on the outer side of the clamping part, it being possible for the inside tube diameter to be constant or variable over the length of the clamping part and smaller in the region of the clamping area than outside the clamping area. The clamping area may in this case run parallel to the tube axis. It is also possible for the clamping area to run obliquely with respect to the tube axis. In the latter case, the drilling tool can be secured better against pulling out of the tool from its clamping restraint.

It is simplest if both the interior outline and the exterior outline of the blank are circular over the length of the clamping part and over the length of the forming part and have a constant diameter. However, it is also possible in principle for the interior outline to be formed in an oval or elliptical manner, at least over the length of the clamping part, the clamping area expediently being arranged in the region of the smaller inside tube diameter. In this way, the wall thickness,

and consequently the strength, of the clamping part can be increased in the region of the clamping area.

A further advantageous configuration of the invention provides that, with a constant outside tube diameter, the inside tube diameter conically diverges at least over part of the length of the forming part toward the free end. This measure allows the cooling channels formed in the forming operation to be widened toward the drill tip. A further modification of the cooling channels over the length of the forming part can be achieved by the interior outline of the blank being formed in an oval or elliptical manner at least over part of the length of the forming part.

A further preferred configuration of the invention provides that a transitional portion which runs conically is provided between the forming part and the clamping part. The transitional portion is advantageously conically formed on the inside between the clamping part and the forming part in the same direction as on the outer side. A step-shaped transitional portion may also be arranged between the clamping part and the forming part. The transitional portion may in this case be formed and dimensioned in such a way that at least one bit seat for receiving a cutting bit can be formed in it there. To improve the flow properties in the cooling channels, it has proven to be particularly advantageous if the flow channel is widened in the transitional portion with respect to the clamping part.

To produce the tubular blank for the non-cutting forming in the production of drilling tools, it is expedient to start with a piece of tube with a constant inside and outside diameter, which is formed, preferably swaged, at least partially over a mandrel from the outside while thereby forming a forming part

that has a thinner wall than a clamping part, or is subjected to a metal-cutting operation, preferably drilled or turned on a lathe, on its inner and/or outer surface. The clamping area may be formed into the outer surface of the clamping part by either a metal-cutting operation or a non-cutting operation.

The invention is explained in more detail below on the basis of several preferred exemplary embodiments. In the drawing:

Figure 1a shows a side view of a finished drilling tool with a helical chip groove, a thickened clamping shaft and an attached drill tip;

Figure 1b shows a section along the sectional line B-B of Figure 1a in an enlarged representation;

Figures 2a to d show four exemplary embodiments of tubular blanks for the production of drilling tools;

Figure 3a shows a tubular blank with a clamping area and an oval inner passage;

Figure 3b shows a longitudinal section through the blank that is shown in Figure 3a;

Figure 4 shows a longitudinal section through a blank with a clamping area formed in the clamping part and a conical inner passage in the forming part.

Represented in Figures 1a and b is a drilling tool which has an integral drill body 10 with helical chip grooves 12 and a formed-on clamping part 16 as well as a drill tip 20 integrally attached to the drill body 10 by means of a soldered location 18. The drill body 10

is produced from a tubular blank 22, which has a central channel 24 passing through it and the wall thickness of which varies over the length (Figures 2a to d). In the production of the drilling tool that is shown in Figure 1, the chip grooves 12 are formed into the forming part 26 by the swaging method. At the same time, the central channel 24 in the region of the forming part 26 is transformed into cooling channels 27, which run along the helical ribs 28 between the chip grooves 12 and the outlet points 30 in the region of the drill tip 20. In the forming operation, the cooling channels 27 are provided in the region of the forming part 26 with a triangular cross section, the outer delimiting side 40 of which has an outwardly convex curvature that is partially concentric to the part-cylindrical outer surface 42 of the ribs 28 concerned and the inwardly adjoining inner delimiting sides 44, 46 of which meet at an acute angle at the edge of a triangle 50 pointing towards the drill axis 48 (cf. DE-A-198 56 986). In the transitional portion 32 between the forming part 26 and the clamping part 16, the cooling channels formed during the swaging method go over steplessly and seamlessly into the central channel in the region of the clamping part.

The drilling tool that is shown in Figure 1a also has a clamping area 17, which is formed in it in the region of the clamping part 16 of the blank by either a metal-cutting or a non-cutting operation. The clamping area 17 may either run axially parallel, as in the case of Figure 1a, or be obliquely aligned as in the case of the exemplary embodiments shown Figures 3a, b and 4. In the case of the exemplary embodiment shown in Figures 3a and b, the interior outline of the central channel 24 is formed in an elliptical manner, at least over the length of the clamping part 16, in such a way that a greater wall thickness is formed on the side of the clamping area 17. The elliptical central channel

24 may also continue into the forming part 26. In this case, the cooling channels 27 are elliptically spiralled in the forming operation.

In the case of the exemplary embodiment shown in Figure 4, the central channel 24 is conically widened over the length of the forming part while having a constant outside tube diameter. With this measure, the cooling channels 27 formed in the forming operation are enlarged toward the drill tip.

The clamping part 16 must absorb clamping forces during the clamping in a tool shaft without thereby undergoing plastic deformation. On the other hand, the blank must be formed in a specific manner by plastic deformation in the region of the forming part 26 to introduce the chip grooves 12. In order to satisfy the conflicting conditions with regard to strength and deformability, the wall thickness of the tubular blank 22 is greater in the clamping part 16 than in the forming part. This can be realized with the inside diameter of the central channel 24 remaining the same by an increased outside diameter in the region of the clamping part 16 (Figure 2a) or with the outside diameter remaining the same by a reduced inside diameter of the central channel 24 in the region of the clamping part (Figure 2b). In the case of the exemplary embodiments that are shown in Figures 2c and d, both the outer wall and the central channel 24 have different diameters in the region of the clamping part 16 and the forming part 26. In the case of Figures 2b to d, an additional transitional portion 32 is provided, which can run conically both on the outer wall and in the central channel 24 (Figure 2d). In the case of the exemplary embodiments that are shown in Figures 2b and c, an inflow chamber 34 with a widened cross section is created in the transitional portion 32 during the forming, as is shown in Figure 1a.

To produce the tubular blanks 22 that are shown in Figures 2a to d, it is possible to start with a piece of tube with a constant inside and outside diameter, which is subjected to a metal-cutting operation, preferably drilled or turned on a lathe, on its inner and/or outer surface, or partially formed, preferably swaged, over a mandrel from the outside while thereby forming a forming part 26 that has a thinner wall than the clamping part 16.

The blank expediently consists of a case hardening steel with a phase transition point of from 480 to 650°C. Preferably used for this purpose is a case hardening steel with a chromium content of less than 2%, preferably a 16 MnCr 5 steel. The case hardening steel is hardened, for example by carburizing or nitriding on the surface, and if appropriate on the inner side, after the forming. The hardness profile thereby achieved in the wall of the tool shaft leads to a high load-bearing capacity.

To sum up, the following can be stated: the invention relates to a tubular blank 22 for the production of drilling tools, the blank having a forming part 26 that can be formed in a non-cutting manner while thereby forming chip grooves 12 and coolant channels, and the finished drilling tool being able to be fitted with a shaft for clamping in a machine tool and with a drill tip 20 provided with cutting edges. In order to allow for the conditions in terms of strength and deformability, the tubular blank 22 has a clamping part 16 which is arranged at the shaft-side end of the forming part 26, is integrally connected to the latter and the tubular wall thickness of which is greater than in the region of the forming part 26.